CLAIMS

1. A distributed feedback type semiconductor layer diode comprising:

a semiconductor substrate;

an optical guide layer formed on said semiconductor substrate, a diffraction grating having a phase shift region being formed between said semiconductor substrate and said optical guide layer; and

an active layer formed on the optical guide layer, wherein

$$\kappa L + A \cdot \Delta\lambda \geqq B$$

where κ is a coupling coefficient of said diffraction grating,

L is a cavity length of said diode,

$\Delta\lambda$ is a detuning amount denoted by $\Delta\lambda = \lambda_g - \lambda$ where λ_g is a gain peak wavelength of said diode and λ is an oscillation wavelength of said diode,

A is a constant from $0.04nm^{-1}$ to $0.06nm^{-1}$, and

B is a constant from 3.0 to 5.0.

2. The distributed feedback type semiconductor laser diode as set forth in claim 1, wherein said phase shift region has a phase shift amount of to $\lambda/4$ to $\lambda/16$.

3. The distributed feedback type semiconductor laser diode as set forth in claim 1, wherein said phase shift region has no diffraction grating structure.

4. The distributed feedback type semiconductor laser diode as set forth in claim 1, wherein said active layer comprises a multiple quantum well structure.

5. The distributed feedback type semiconductor laser diode as set forth in claim 4, wherein said multiple quantum well structure is compression-strained.

6. The distributed feedback type semiconductor laser

diode as set forth in claim 4, wherein said multiple quantum well structure is tensile-strained.

7. A distributed feedback type semiconductor layer diode comprising:

a semiconductor substrate;

an InGaAsP optical guide layer formed on said semiconductor substrate, a diffraction grating having a phase shift region being formed between said semiconductor substrate and said InGaAsP optical guide layer; and

a 0.7% or more compression-strained InGaAsP multiple quantum well active layer formed on said InGaAsP optical guide layer, wherein

$\kappa L + 0.05 \cdot \Delta\lambda \geqq 3.8$

where κ is a coupling coefficient of said diffraction grating,

L is a cavity length of said diode, and

$\Delta\lambda$ is a detuning amount denoted by $\Delta\lambda = \lambda_g - \lambda$ where λ_g is a gain peak wavelength of said diode and λ is an oscillation wavelength of said diode.

8. A distributed feedback type semiconductor layer diode comprising:

a semiconductor substrate;

an InGaAsP optical guide layer formed on said semiconductor substrate, a diffraction grating having a phase shift region being formed between said semiconductor substrate and said InGaAsP optical guide layer; and

a 0.7% or more tensile-strained InGaAsP multiple quantum well active layer formed on said InGaAsP optical guide layer, wherein

$\kappa L + 0.05 \cdot \Delta\lambda \geqq 3.4$

where κ is a coupling coefficient of said diffraction grating,

L is a cavity length of said diode, and

$\Delta\lambda$ is a detuning amount denoted by $\Delta\lambda = \lambda_g - \lambda$ where λ_g is a gain peak wavelength of said diode and λ is an oscillation wavelength of said diode.

9. A distributed feedback type semiconductor layer diode comprising:

a semiconductor substrate;

an AlGaInAs optical guide layer formed on said semiconductor substrate, a diffraction grating having a phase shift region being formed between said semiconductor substrate and said AlGaInAs optical guide layer; and

a 1.0% or more compression-strained AlGaInAs multiple quantum well active layer formed on said AlGaInAs optical guide layer, wherein

$\kappa L + 0.05 \cdot \Delta\lambda \geqq 3.4$

where κ is a coupling coefficient of said diffraction grating,

L is a cavity length of said diode, and

$\Delta\lambda$ is a detuning amount denoted by $\Delta\lambda = \lambda_g - \lambda$ where λ_g is a gain peak wavelength of said diode and λ is an oscillation wavelength of said diode.

10. A distributed feedback type semiconductor layer diode comprising:

a semiconductor substrate;

an AlGaInAs optical guide layer formed on said semiconductor substrate, a diffraction grating having a phase shift region being formed between said semiconductor substrate and said AlGaInAs optical guide layer; and

a 1.0% or more tensile-strained AlGaInAs multiple quantum well active layer formed on said AlGaInAs optical guide layer, wherein

$\kappa L + 0.05 \cdot \Delta\lambda \geqq 3.4$

where κ is a coupling coefficient of said diffraction grating,

L is a cavity length of said diode, and

$\Delta\lambda$ is a detuning amount denoted by $\Delta\lambda = \lambda_g - \lambda$ where λ_g is a gain peak wavelength of said diode and λ is an oscillation wavelength of said diode.

11. A method for manufacturing a phase-shifted distributed feedback type semiconductor laser diode, comprising the steps of:

forming a plurality of samples of said phase-shifted distributed feedback type semiconductor laser diode having different normalized coupling coefficients κL and different detuning amounts $\Delta\lambda$;

measuring power penalties of said samples connected to an optical fiber;

plotting values of said normalized coupling coefficients κL and said detuning amounts $\Delta\lambda$ of said samples with said power penalties in a graph;

determining $\kappa L + A \cdot \Delta\lambda = B$ where A and B are constants in order to divide said samples into first and seconds areas in said graph, so that most of said samples belonging to said first area have power penalties smaller than a definite value and most of said samples belonging to said second area have power penalties not smaller than said definite value; and

forming a new phase-shifted distributed feedback type semiconductor laser diode having a normalized coupling coefficient κL and a detuning amount $\Delta\lambda$ satisfying $\kappa L + A \cdot \Delta\lambda \geqq B$.

12. The method as set forth in claim 11, wherein A is from $0.04nm^{-1}$ to $0.06nm^{-1}$ and B is from 3.0 to 5.0

13. The method as set forth in claim 11, wherein said phase-shifted distributed feedback type semiconductor laser diode comprises a λ/n phase shift region in a diffraction grating where λ is an oscillation wavelength of said diode

and n is 4 to 16.

14. The method as set forth in claim 11, wherein said phase-shifted distributed semiconductor laser diode comprises a 0.7% or more compression-strained InGaAsP multiple quantum well active layer, A and B being $0.05nm^{-1}$ and 3.8, respectively.

15. The method as set forth in claim 11, wherein said phase-shifted distributed semiconductor laser diode comprises a 0.7% or more tensile-strained InGaAsP multiple quantum well active layer, A and B are being $0.05nm^{-1}$ and 3.4, respectively.

16. The method as set forth in claim 11, wherein said phase-shifted distributed semiconductor laser diode comprises a 1.0% or more compression-strained AlGaInAs multiple quantum well active layer, A and B are being $0.05nm^{-1}$ and 3.0, respectively.

17. The method as set forth in claim 11, wherein said phase-shifted distributed semiconductor laser diode comprises a 1.0% or more tensile-strained AlGaInAs multiple quantum well active layer, A and B being $0.05nm^{-1}$ and 3.0, respectively.